

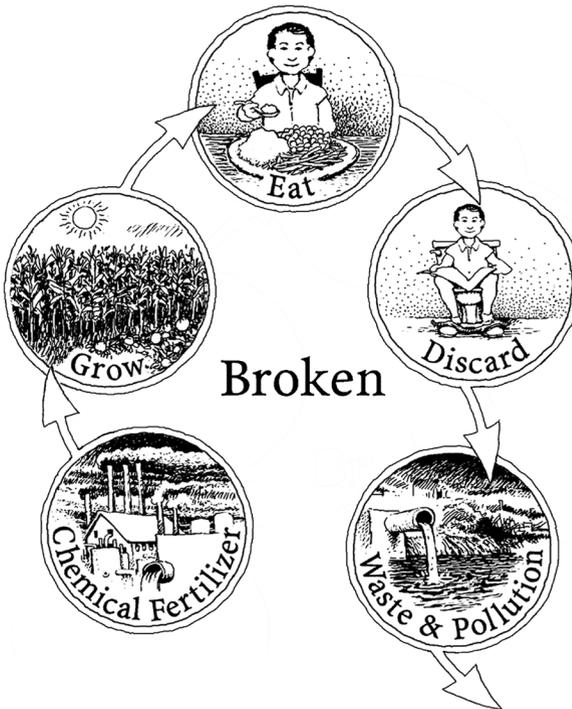
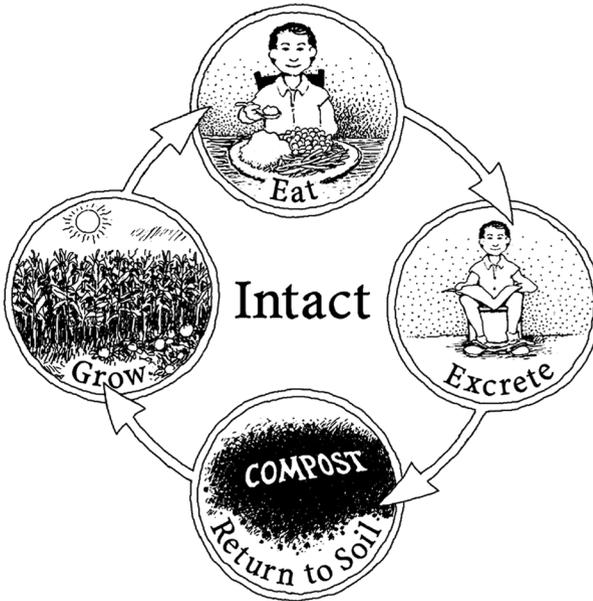
## Chapter Fourteen

### The Tao of Compost

*Tao* or *Dao* is a Chinese word signifying “way,” or “path.” It represents the natural unfolding of the universe, something that we can learn to understand simply by living everyday life.<sup>1</sup> One thing we can learn about, if we’re paying attention, is something called a nutrient cycle, especially the “human nutrient cycle.” When an organism consumes food (nutrients), that organism’s excretions become food for other organisms. That’s the way of nature, an endless cycle. When we dispose of our excretions as waste, dumped into landfills wrapped in waterproof liners like gigantic disposable diapers, the cycle is broken. Composting feeds our excretions to beneficial microorganisms, thereby returning them back to the earth, and the nutrient cycle is complete.

Organic material should be recycled by everyone on the planet. This is the sort of thing we could be teaching our children in schools and adults in universities. Learning how to live on our planet in ways that are symbiotic rather than pathogenic is critical to the long-term survival of the human species. Extinction should not be an option. Yet, humans act as though they’re pathogens on Earth, acting as if there is no real future. What about a thousand generations from now? Who cares? Nobody. Why not? Why are we consuming resources as fast as possible while creating toxic wastes in increasing amounts? These would normally be considered characteristics of pathogens.

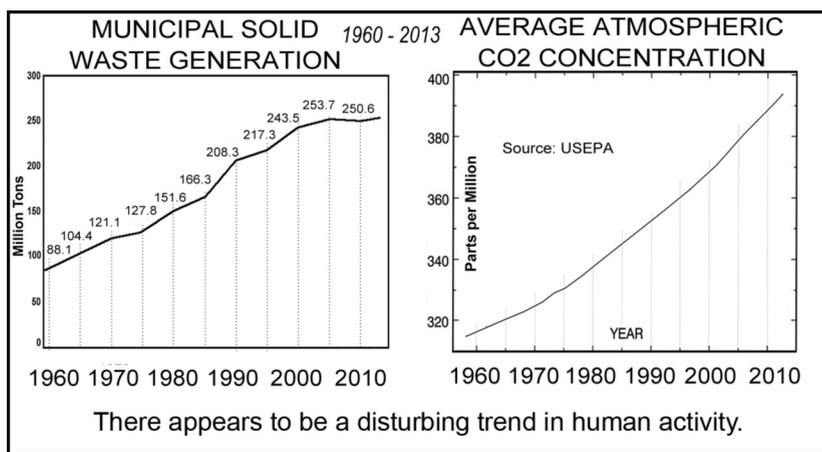
# HUMAN NUTRIENT CYCLE



It's safe to say that the government is not going to teach you how to make compost and certainly not how to make compost with humanure. It doesn't matter what country you live in. It's important to learn how to take care of yourself on this planet. One thing you should know is that there are invisible beings and they're here to help. Organic material feeds them if you pile it above ground. They convert it back to earth, and will do so even with your excretions, but you need to know some of the techniques that make it work.

I've had lots of feedback since I published the first edition of this book — hundreds of letters until the internet came along, then hundreds of emails. One concern some people have is that they're going to *have* to “*shit in a bucket!*” What about the population centers, they ask? What about high-rise apartments? How do you compost humanure there? Recently someone asked me, “What about New York City?” My response is, what about the 2.6 billion people with no toilets at all? What about the billion people who still open defecate? What about the people who live without electricity or running water? What if you want a toilet somewhere where water toilets are impossible? Composting is an important skill to learn, which could benefit many people worldwide. Once you see tears in the eyes of an old woman because she has a toilet inside her dwelling for the first time in her life, you might understand.

No, I'm not concerned about New York City, or about high-rise



apartments, nor do you have to worry about having to use a compost toilet. Water toilet cultures already have their hands full dealing with the polluted water. When the British started installing water closets, the population of the world was less than a billion people. They weren't thinking that the population would increase by a factor of six in the next century. They couldn't have foreseen the millions of tons of antibiotics, pharmaceuticals, and toxic chemicals that would be flushed down toilets in the future. They could not have predicted climate change and the planetary disruptions that would result from increasingly erratic weather events, where power would be knocked out for extended periods of time and water toilet systems would no longer function.

One question I'm often asked is how did I get into composting humanure in the first place? Well, when I graduated from college in the 1970s, I moved into an abandoned farmhouse on 212 acres. There was no running water. There was a pit latrine out back and a spring down over the hill where I fetched water in five-gallon jugs. There was a big pile of old sawdust in the woods nearby, which I used to mulch my first garden. It was left over from timbering and had been rotting in the woods for fifteen years. This place was my introduction to outhouses; the smells, the bugs, and the inconvenience.

Then I moved to a stone cottage about ten miles away. The agreement was that I would do the finish carpentry on the cottage in exchange for living in it. It had no electricity, running water, or even an outhouse. So I constructed a crude toilet from a five-gallon bucket, went back and got some of that sawdust, and found that, as long as the sawdust was covering the toilet contents, the toilet could be used indoors with no odor whatsoever. When the toilet container became full, I took it out back and dumped it in a pile. If the pile smelled, I covered it with weeds. After a year of this, I moved again and left the pile behind. That was 1977. A few years later the property owners used that pile of compost to plant blueberry bushes.

In 1979, I bought my own land. There was no electricity or running water there, either; nothing, in fact, just woods. I remembered the

“sawdust toilet” in the stone cottage and quickly set up a new one. This time I built a compost bin. After fifteen years of using the compost toilet, I found myself in grad school and decided to write my thesis on the toilet system. It would give me an opportunity to research what was going on in the compost. I ended up publishing the thesis as the first edition of *The Humanure Handbook*. Today, over forty years have passed since that first compost toilet in the stone cottage, and I still exclusively use a compost toilet at home and in my business. I’ve used all my household compost to grow the food that I and my family have eaten, and I’ve used all the compost generated at my business to grow flowers, shrubs, and trees. Over that time period, I’ve learned a few things that I want to pass on. The information may come in handy in the event of a prolonged emergency, even if you live with a flush toilet.

#### PRIMAL COMPOST

Try to imagine yourself in an extremely primitive setting, perhaps sometime around 10,000 BC. Imagine that you're slightly more enlightened than your brutish companions and it dawns on you one day that your feces should be disposed of in a different manner. Everyone else is defecating in the back of the cave like dogs, creating a smelly, fly-infested mess and you don't like it.

Your first revelation is that smelly excretions should be deposited in one place, not spread around for everyone to step in, and they should be deposited away from one's living area. You watch the wild cats and see that they each go to a special spot to defecate. But the cats are still one step ahead of the humans, as you soon find out, because they cover their excrement.

When you've shat outside the cave on the ground in the same place several times, you see that you've still created a foul-smelling, fly-infested mess. Your second revelation is that the refuse you're depositing on the ground should be covered after each deposit. So, you scrape up some leaves every time you defecate and throw them over the feces. Or you pull some tall grass out of the ground and use it for cover.

Soon your companions are also defecating in the same spot and covering their fecal material as well. They were encouraged to follow your example when they noticed that you had conveniently located the defecation spot between two large rocks and positioned logs across the rocks to provide a convenient perch, allowing for care-free defecation.

A pile of dead leaves is now being kept beside the toilet area to make the job of covering the deposits more convenient. As a result, the offensive odors of human feces and urine no longer foul the air. Instead, it's food scraps that are generating odors and attracting flies. This is when you have your third revelation: Food scraps should be deposited on the same spot and covered as well. Every stinky bit of organic refuse you create is now going to the same place and is being covered with a natural material to eliminate odor. This hasn't been hard to figure out, it makes good sense, and it's easy to do.

You've succeeded in solving three problems at once: no more human excrement scattered around your living area, no more garbage, and no more offensive odors ruining your day. Eventually, you begin to realize that the illnesses that were prone to spread through the group have subsided, a fact that you don't understand, but you suspect may be due to the group's new-found hygienic practices.

Quite by accident, you've succeeded in doing one very revolutionary thing: you've created a compost pile. You begin to wonder what's going on when the pile gets so hot it looks as if it's steaming. What you don't know is that you've done exactly what nature intended you to do by piling your organic refuse together with biodegradable cover materials. Nature has "seeded" your excrement with microscopic creatures that proliferate in and digest the pile you've created. In the process, they heat the compost to such an extent that disease-causing pathogens resident in the humanure are destroyed. The microscopic creatures would not multiply rapidly in the discarded refuse unless you created the pile, and thereby the conditions that favor their proliferation.

Finally, you have one more revelation. You see that the pile, after it gets old, sprouts all kind of vibrant plant growth. You put two and two together and realize that the stinking refuse you carefully collected

has been transformed into rich earth and ultimately into food. Humankind has just taken another step up the ladder of evolution.

There is one basic problem with this scenario: it didn't take place twelve thousand years ago — it's taking place now. Compost microbes are apparently very patient. Not much has changed since 10,000 BC in their eyes. The invisible creatures that convert humanure into compost don't care what composting techniques are used today any more than they cared what techniques may have been used eons ago, so long as their needs are met. And those needs haven't changed in human memory, nor are they likely to change as long as humans roam the Earth. Those needs include: (1) temperature (compost microorganisms won't work if frozen); (2) moisture (they won't work if too dry or too wet); (3) oxygen (they won't work without it); and (4) a balanced diet (otherwise known as balanced carbon and nitrogen). With a little imagination, we can see the microbes as a working army of microscopic people who need the right food, water, air, and warmth.

The art of composting, then, remains the simple and yet profound art of providing for the needs of invisible workers so they work as vigorously as possible, season after season. And although those needs may be the same worldwide, the techniques used to arrive at them may differ from eon to eon and from place to place.

There are thousands of geographic areas on the Earth, each with its own unique human population, climate, and available organic materials, so there will potentially be thousands of individual composting methods, techniques, and styles. What works in one place on the planet for one group of people may not work for another group in another geographic location. For example, we have lots of sawdust in Pennsylvania, but no rice hulls. Composting should eliminate local waste and pollution as well as recover resources, and a compost maker will strive to utilize in a wise and efficient manner whatever local organic materials are available.

## WHICH CAME FIRST — THE GARDEN OR THE COMPOST?

The garden. That's why we make compost, to grow plants. If you have no need for compost or plants, a compost toilet may not be the wisest choice for you, unless your organic material is being collected for you by someone else and composted elsewhere.

If you've been reading this book, you know that manures are not that easy to get for your organic garden (remember the mirror?). But we're animals too and we produce manure every day, so if we can recycle our own, then we have a constant supply. But composting humanure is not the same as composting yard trimmings. There are things you want to know.

First, human excrement nourishes a compost pile. It provides much needed nitrogen and moisture. Many people with backyard compost piles don't really see much biological heat developing. They're piling up leaves and garden weeds, which do rot rapidly but may not spark a thermophilic response from the microbes. Add nitrogen and moisture, and you will see heat becoming generated. Food scraps are enough to create thermophilic conditions since they're moist and tend to be high in nitrogen, as are most green plant materials. Add humanure, and you have the right mix.

But humanure smells bad. Mother Nature makes things smell bad so we will bury them. Covering with earth has been the age-old solution to bad smells. The Earth Closet made perfect sense in this regard. It did block the odor. Decaying corpses smell horribly, but not if they're buried in dirt. That old sawdust pile showed me that it's not only earth that blocks odors; ground-up plant material works just as well. The difference is that ground plant material also sets the stage for composting. The microbes need the carbon to balance the nitrogen. Earth doesn't provide the carbon, but plant cellulose does.

There are four requirements for a compost toilet to function correctly: (1) the cover material; (2) the toilet; (3) the compost bins; and (4) human management.

## IT'S ALL ABOUT THE COVER MATERIAL

For a water toilet to function, you need water. For a compost toilet to function, you need a carbon-based cover material. This is the limiting factor with compost toilet systems. If you don't have the cover material, you won't have a compost toilet. When I travel to a far-off land to help people set up compost toilets, the first thing I look for is the cover material. You can't use ashes, you can't use sand, you can't use lime, and you can't use dirt. It must be a plant derived material.

Cover materials we have successfully used around the world include sugarcane bagasse, which is ground and shredded sugarcane stalks used in the sugar and rum industries, found in most tropical climates. It contains residual sugar as well as cellulose, and microbes love it. Of course, sawdust can be found worldwide. The best is what comes from cutting trees into boards, beams, or posts. *Sawdust is not wood chips* and it is *not wood shavings*. Chips come from a chipper and they're too big for bacteria to eat. Shavings come from planing machines, and they also produce relatively large pieces of wood, which bacteria have a hard time dealing with. In big municipal compost piles, wood shavings may work fine, given enough time. In backyard compost piles they will slow your pile down, especially if they've been kiln-dried.

Rice husks or hulls, a by-product of the rice industry, are often used for cover material. They also tend to slow down the compost in smaller piles, but they do work. The byproducts of cassava distilleries have been successfully used as cover materials when composting sewage sludge in China. Other promising cover materials in compost piles include olive mill by-products and sweet sorghum bagasse.<sup>2</sup> A lady in California emailed me and said that she had been using a compost toilet for years but had trouble finding cover material, so she got a chipper/shredder and started shredding blackberry brambles, describing them as "an invasive nuisance around here...they are very abundant and grow quickly (about 15 feet a year). Smaller branches and twigs with leaves on them (usually willow around here) can also be shredded into a great cover material."

## TWO USES FOR COVER MATERIAL

There are two categories of cover material: (1) the cover material *for inside the toilet*, and (2) the cover material *for your compost pile*. They are not the same. Inside the toilet you will need a fine material that has a small degree of residual moisture. Sawdust from trees, with residual sap, is perfect. If you have dry sawdust such as from kiln-dried boards, pile it outside and let it get rained on, rehydrated, and thereby biologically reactivated. The residual moisture is what makes it an effective biofilter. Bacteria live in the biofilms coating the wood particles. If you're using bone-dry sawdust as a cover material and you notice odor escaping from the toilet, mist the cover material with water when you're adding it to the toilet. If you have dry sawdust or wood shavings, pile them outside and let them get rained on and rot for a while.

If you use an appropriate cover material in adequate quantities, all odor will be blocked, and no flies will be attracted to the compost. This can't be emphasized enough. *The cover material is the biofilter*, and it's of utmost importance. It's the cover material that eliminates the need for venting. When you're using appropriate cover material, a standard toilet seat lid (other than the cover material) is all that is required to cover the toilet contents. The loo receptacle never needs its own separate lid until it's removed from the loo cabinet.

On the other hand, the cover materials used *on the compost pile* don't have to be in fine particles and can be either dry or moist. Straw works great. Hay is good, as are grasses, weeds, leaves, or anything from a plant source that is clean and doesn't smell bad. You don't want to use barnyard manures as cover material because they have unpleasant odors. Your toilet and your compost bin should be completely odor free. With proper management, they will be. Cover materials help keep your pile aerobic by creating tiny interstitial air spaces in the compost. That's all the oxygen your compost will need. Large bulky materials are not needed in compost piles to create air spaces. We're talking about microscopic organisms here. If the compost is above ground and not under water, it will have air spaces in it. Turning, digging, or chopping

the compost is not necessary. Have a large squash? Just throw it in. You don't need to chop it up first. Stick a thermometer in your compost, and keep an eye on it. If it's heating up above ambient temperatures, your compost is active.

During a cold winter, cover material stored outside can freeze solid and should be covered or insulated in some manner. Containers filled with sawdust stored in a basement, heated garage, or enclosed porch will provide toilet cover material throughout the winter months.

## YOU WILL NEED A LOO

The compost toilet, also known as a *loo*, is used to collect the toilet material, and it's the simplest part of the system. The toilet must have receptacles that are sturdy, waterproof, and durable. If you're emptying the receptacles by hand, they must be small enough to be handled by one or two people. One person can handle five gallons of capacity, two people can handle fifteen gallons. If you're alone and five gallons is too much, empty the receptacle when it's half full; don't wait until it's too full to handle. Although this seems like common sense, you'd be surprised how many people can't figure this out.

All urine, fecal material, and toilet paper go into the loo, as does anything else that would normally go into a flush toilet. You can also throw in the cardboard tubes from the center of toilet paper rolls. You can vomit in the toilet. Just don't put food scraps in the toilet because you'll risk a fruit fly infestation. You *can* put food scraps in the loo *after* the receptacle has been removed from the toilet housing, and a lid has been placed on it. It's all going to the same compost pile anyway.

You can make your own loo for very little money out of scrap wood, and you can find recycled plastic receptacles available cheap or free. You should construct the loo to fit the receptacles, so make sure you have several receptacles that are exactly the same size, otherwise they're not all going to fit the loo. I use five five-gallon receptacles in my bathroom loo, one in the loo cabinet and four on standby with lids. When four are filled and set aside, with lids snugly attached, they all go to

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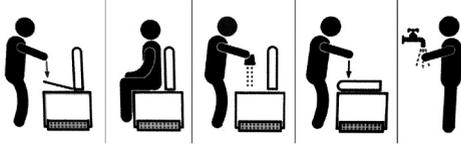


## COMPOST TOILETS

Note lid stored behind receptacle.

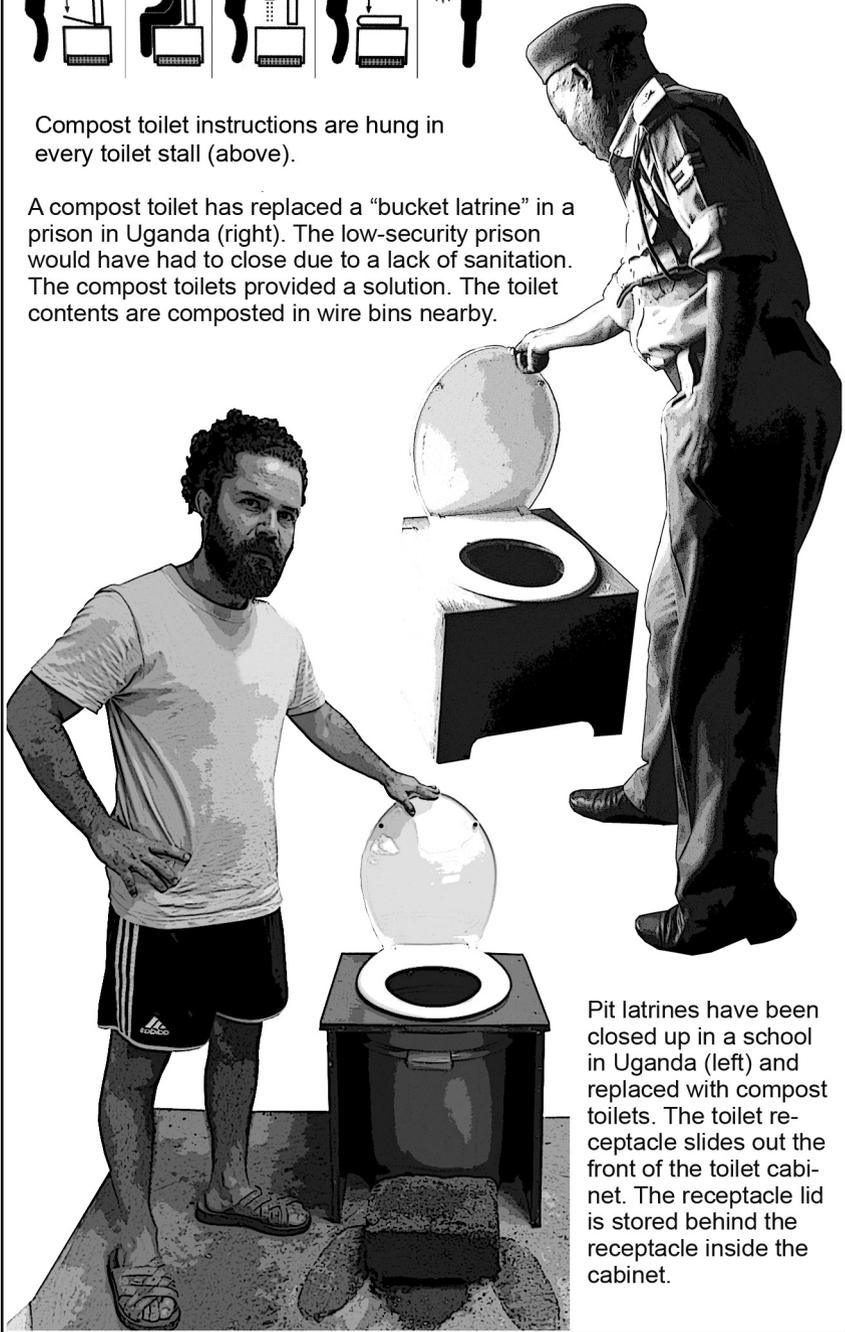
CTs can be made of wood, plastic, or other materials. They have removable receptacles that allow for the collection and composting of the toilet material. The unit pictured below is in Mozambique. It is a dry toilet chute repurposed to cover a plastic receptacle. The chute is lifted off when the receptacle is removed.





Compost toilet instructions are hung in every toilet stall (above).

A compost toilet has replaced a “bucket latrine” in a prison in Uganda (right). The low-security prison would have had to close due to a lack of sanitation. The compost toilets provided a solution. The toilet contents are composted in wire bins nearby.

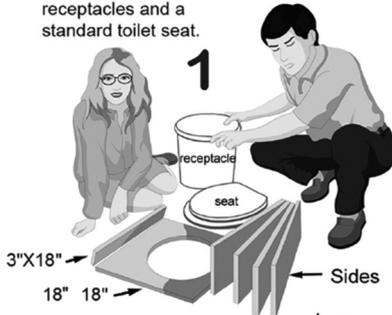


Pit latrines have been closed up in a school in Uganda (left) and replaced with compost toilets. The toilet receptacle slides out the front of the toilet cabinet. The receptacle lid is stored behind the receptacle inside the cabinet.

# BUILD A SIMPLE COMPOST TOILET

1" = 2.54 cm

1. Start with 4 identical receptacles and a standard toilet seat.

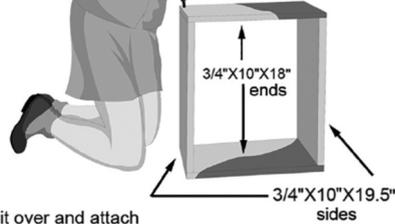


- (2) 3/4"x10"x18" ends
- (2) 3/4"x10"x19.5" sides
- (4) 3/4"x3"x12" legs
- 3/4" plywood 18"x18" Top, front
- 3/4" plywood 3"x18" Top, back
- (2) Hinges 3" (7.6 cm) or similar

2

2. Screw the four boards together.

Finished size = 18"x21"



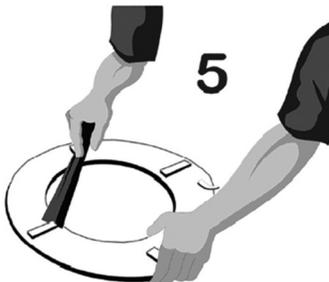
4. Flip it over and attach the four legs to the inside of the box. The receptacle must protrude through the plywood top by about 1/2". Adjust legs accordingly.

3



3. Screw the 3" X 18" board to the box. Leave the 18" X 18" plywood top attached only by the hinges.

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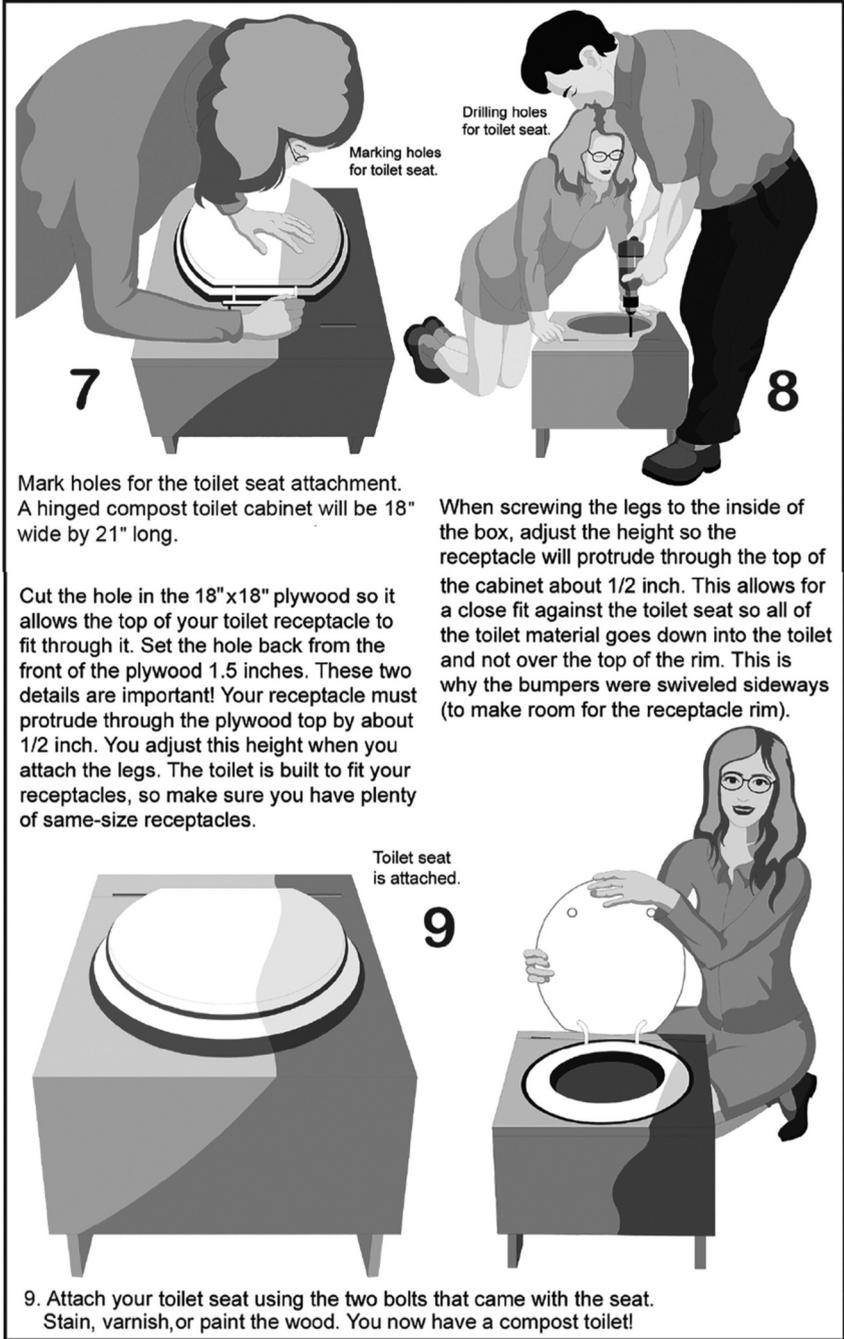


5. Swivel the plastic bumpers sideways so the top of the receptacle rim will almost touch the toilet seat ring. The adjusted toilet seat is shown at right. You will have to drill a new hole for each bumper.

Black dots show original holes. Red dots show where the new holes were drilled underneath the bumpers. The holes accommodate the pegs on the underside of the bumpers.

6





the compost pile at the same time while the fifth is in use. Although they're "full," there is still about a gallon of room in each receptacle to add food scraps from your kitchen compost pail. This does make the receptacle heavier, but if that's not a problem, this is a convenient way to get all your organic material out to the compost bin at the same time.

Why not just "shit in a bucket"? Why not just clamp a toilet lid on a five-gallon bucket and defecate in that? Go ahead, if that's your style. It works, but it's neither comfortable nor stable. Lean over to wipe yourself and watch the bucket go out from underneath you. It will not be a pretty sight. If you're a water toilet user, why not just fill a bowl with drinking water and shit in that, then dump it down a sewer drain? The concepts seem ridiculous, but people do ask these questions, especially those who don't want to spend any money on a toilet.

Another question often asked is, "Why not just put the toilet over an outdoor compost bin?" Again, go ahead, if that's what you want to do. Most people like their loo indoors, where it's convenient, secure, and comfortable, year-round. In my house, I have a loo in my office, another in a guest bedroom, and another in the downstairs bathroom. I also have one in a separate guest quarters and two in my business office. All are odor free when properly used. Why would I want to have to go outside or to a single indoor location to use a toilet when all I have to do is once a week (for a family of four) or once a month (for a single person) empty four compost receptacles into an outdoor bin instead? A bin underneath your house will still need to be emptied, you're still going to produce the same amount of compost, and you'll eventually want to get it to your garden or flower beds. These are also important considerations. It may not be so convenient to manage the compost when it's under the house, or to have to move it up to ground level during the growing season if it's in a basement.

Always keep the toilet contents covered. If you're using an adequate amount of appropriate cover material, your loo will be odor-free, as will your compost bin. If your nose picks up bad odors, or your eyes see flies, you're not keeping the compost covered correctly. You need a nose that works and eyeballs that work to be able to manage a compost toilet

system. A brain that works helps, too. A compost toilet is “the thinking person’s toilet.”

Add more cover material if you smell anything. Make sure it’s fine enough and has residual moisture when covering your *toilet* contents. If it’s light and fluffy and dry like bagged wood shavings, it will not be as effective an odor blocker in your toilet, and you will need to use more of it, filling your loo receptacle too rapidly. Wet it down, and let it rot, even for years if needed; *then* use it for covering the toilet contents.

In the compost *bins*, always cover the contents thoroughly. If you smell odors, add more cover material. A lady emailed me and said her compost bin smelled bad. I emailed back, “Add more cover material.” She replied a week later and said her bin still smelled bad. I emailed back, “Add more cover material.” This went on for a while, back and forth, until she finally stopped emailing me. She must have eventually added enough cover material. The cover material can be three feet deep if it has to be (it doesn’t); it won’t hurt the compost. You’re going to move it aside as you add new material anyway. You should see nothing on top of your bin but cover material.

The instructions are so simple, it’s ridiculous. If it smells or attracts flies, add cover material until it doesn’t. If this is too complicated, you’re probably not a good candidate for a compost toilet.

With enough containers, a compost toilet system can be used for any number of people. If you’re using one in your home and you’re visited by thirty people all at once, you’ll be very happy to have empty containers on hand to replace any that fill up. You will also be happy that you will not have to empty any compost containers until after your company leaves, because you can set them out of the way, with lids, and then empty them whenever it’s convenient.

Experience has shown that 150 people will require four five-gallon containers during a summer evening party (because the men tend to pee outside). Therefore, always be prepared for the unexpected and have extra toilet receptacles available, as well as extra cover material. For every full compost container carried out of a toilet room, a full,

## COMPOST TOILETS

In a school in Nicaragua (left), using a GiveLove.org model with a 5-gallon lift out receptacle, and in Haiti (right) using a drum receptacle that slides out the front of the toilet cabinet.



Pallet compost bins in Nicaragua. One side is almost filled with toilet material.



same-size container of cover material will need to be carried in.

Finally, there is no need to use chlorine to rinse compost receptacles. Chlorine is a chemical poison that is detrimental to the environment and is totally unnecessary for use in any humanure recycling system. Simple soap and water are adequate.

## THE COMPOST BINS

This is the third necessary element of a compost toilet system. Notice I say bins, plural, because you will need at least two, one to fill until full and another to fill while the first one cures or ages. The purpose of the bin is to contain the organic material vertically above ground in such a manner that dogs, goats, horses, and other critters won't be able to get into it. Holding it above ground maintains an aerobic system. Once a bin is filled, leave it alone for approximately one year while you're filling the next one. Size the bins so it takes a year to fill them. If you're a larger group, you may need either several bins or larger bins. A standard family bin size is *roughly* 5 feet square and 4 feet high (1.5m square and 1.2m high).

You can throw up a quick bin in ten minutes using four wood pallets standing on edge. Just lean them against each other and run a couple of screws in each side to hold them together. If you don't have screws, tie them together with something. If you need larger bins, such as for a school, make them two pallets wide, but not much wider. You need to be able to reach into the middle of the bins from either side to manage the compost. You can make them as *long* as you want, however.

Position the bins on soil, not on concrete. Some sanitary professionals may imagine that a compost pile is like a cesspool leaching bad things into the ground, and they insist that a barrier must exist between the compost and the soil. But the soil/compost interface is important for several reasons. It provides a biological conduit for micro- and macroorganisms to enter and exit the compost pile. It also provides an area for compost microbes to reside after the bin is emptied; these microbes help inoculate the next pile. The upper few inches of soil also



Construction of compost loos in Mongolia (above) cost about \$6 U.S. each to build, including labor, in 2006. The hut below is a compost toilet in northern Uganda. The reed compost bin sits behind it.



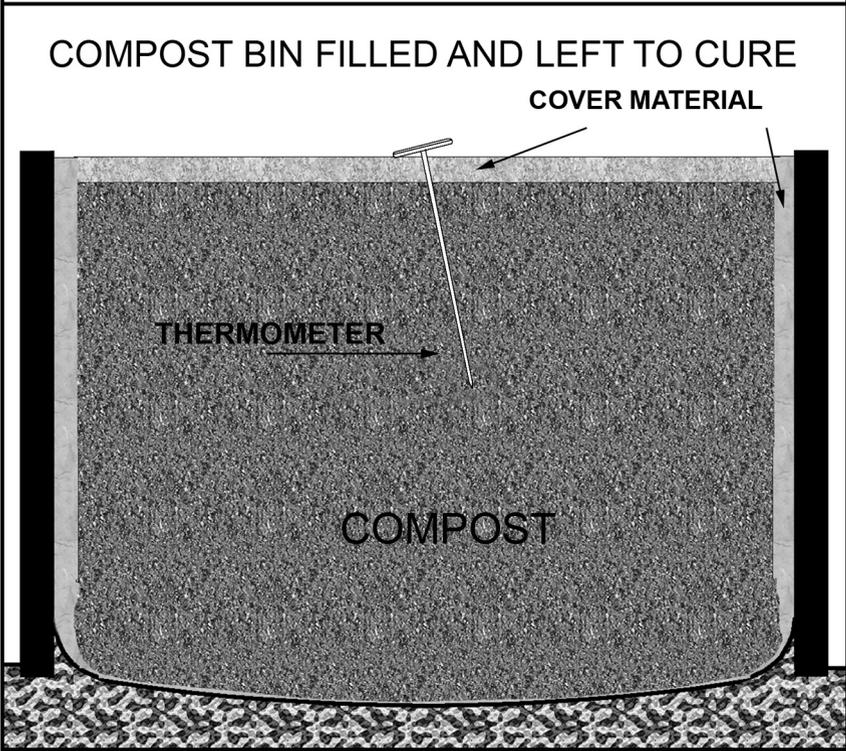
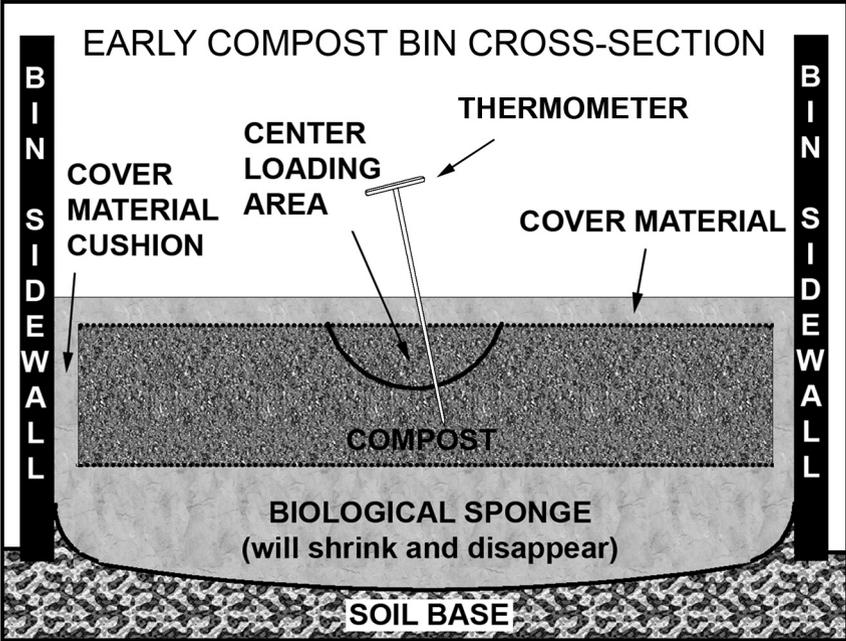
act as a buffer for excess liquid, absorbing it when needed. I have seen, photographed, and videotaped leachate seeping out the bottom of humanure compost piles situated on concrete pads. Not *much* leachate, but enough to step in and track around, enough to breed maggots. If the compost had been on a soil base, these problems would not have existed.

Always dish the soil base to create a bowl underneath the compost pile. Take the dirt you dig out — and it doesn't need to be much — and throw it up against the inside of the bin walls around the bottom edges. You now have a shallow depression under your bin providing extra insurance against any leachate seeping out the bottom.

Before adding any toilet material to your bin, first lay a “biological sponge” in the bottom. This is a cushion of grasses, weeds, leaves, hay, straw, or whatever else you have on hand and whatever you're using for cover material, at least 18 inches or more. Thicker is fine; it will compress down and disappear in the finished compost.

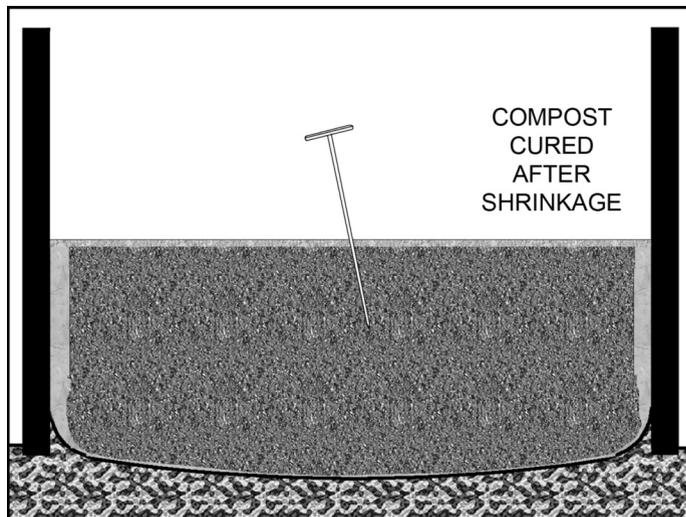
Put enough of a biological sponge in the bottom so that you can open a hole in it to place your first organic deposit, then rake the sponge material back over the deposit and add cover material. The fresh deposit, which may be toilet material, is now buried in the cover material. When adding additional material to your bin, using a dedicated tool such as a shovel, fork, or rake, peel open the cover material and dig into the existing compost to create a depression, dump the fresh material into the depression, then rake the cover material back over it. Add more cover material. Don't let your compost pile become shaped like the Matterhorn — keep it flattened.

Always keep a compost thermometer in the center of your active pile. Twenty-inch thermometers are inexpensive, and they give you a constant reading letting you know what's going on in your pile. Every now and then someone emails me and says his compost isn't getting hot. I ask him what the temperature is. He says he doesn't know; he's not using a thermometer. I ask, “How do you know it's not getting hot?” He says, “It *looks* like it's not hot.” I tell him to get a thermometer, then report back with actual data, not speculation.



Pull the thermometer out before adding new material. By adding incoming material into the center of the compost pile, you achieve some important things: You inject the new material into the most active part of the pile; you cover it thoroughly, not only with cover material, but also with existing compost; and you create a cover material cushion around the *outer edges* of the compost, thereby enveloping the compost in cover material, like a blanket. This insulates the pile, keeps the outside edges of the compost from cooling down, and keeps compost from falling out of any gaps in the bin walls, such as happens with pallet bins. By using a cover material cushion *around* your compost, you can use any kind of bin: wood, block, brick, metal, or plastic, and holes, spaces, or gaps are not needed in the side walls for aeration. Air is entrapped in the cushion. Just make sure you have an earth bottom. You could call this “center feeding” a compost pile, as opposed to the “layering” that seems popular in some circles. Layering is loosely defined as adding new material to the top of the compost pile in layers, like lasagna, and is not recommended when composting humanure.

Speaking of pallet bins (or any bins), if you have straw bales, you can peel off “chips” from the bales, which are flat straw sections a few inches thick, and position them flat against the inside of the bins to line the interior walls before adding your organic material. This insu-



lates your pile, keeps compost from falling out between gaps in the sidewalls, and provides an aerated space enveloping the compost.

A three-bin system in cold climates is good because a center bin for storing cover materials can be constructed with a roof or covering over it. By keeping the cover material dry (straw bales for example), it won't freeze solid and will remain available for use all winter. When you have a sudden large quantity of cover material available, such as an influx of grass clippings, weeds, or leaves, you can also place them in the center bin for storage and use them to cover the compost as needed. It is assumed that you do not use any poisonous chemicals on your lawn. If you do, bag the lawn clippings, take them to the nearest toxic waste dump, and reflect on your folly.

Every year around the summer solstice (late June), I start a new compost pile at home. During late spring the old pile can look as though it's full as if it can't take any more material, but it will. This is due to the constant shrinkage of the compost pile. When the pile is fully built, it is covered over with a nice layer of straw, leaves, grass clippings or other clean material (without weed seeds) to insulate it and to act as a biofilter; then it is left to age, *undisturbed*. No turning is needed. Never add *anything* to a curing compost pile!

The previous year's bin has been emptied by this time, and a new batch of compost can now be started in that bin, following the same procedure as the first — with a concave earth floor, biological sponge, cover material envelope, and center-feeding procedure. When that bin is nearly full (about a year later), the first one can begin to be emptied onto the garden, berries, orchard, or flower beds. If you're not comfortable using your compost for gardening purposes for whatever reason, use it for flowers, trees, shrubs, or berry bushes.

A compost pile can accept a huge amount of organic material. Even though the pile may seem to be full, as soon as you turn your back it will shrink down and leave room for more material. One common concern among neophyte humanure composters is that the pile looks as if it's filling up too fast. More than likely, the compost pile will keep taking the material as you add it because the pile is continuously shrink-

## COMPOST TOILET REVIEW

DO — Collect urine, feces, and toilet paper in the same toilet receptacle. Urine provides essential moisture and nitrogen.

DO — Keep a supply of clean, organic cover material handy to the toilet at all times. Rotting sawdust, peat moss, leaf mould, and other such cover materials prevent odor, absorb excess moisture, and balance the C/N ratio.



DON'T — Segregate urine or toilet paper from feces.

DON'T — Turn the compost pile. Sit back and relax and let the microbes do the work for you. Once your pile is built, let it age in peace, undisturbed, for approximately a year.

DON'T — Use lime or wood ashes on the compost pile. Put these things directly on the soil.

DO — Keep another supply of cover material handy to the compost bins for covering the compost pile itself. Coarser materials, such as hay, straw, weeds, leaves, and grass clippings, prevent odor, trap air in the pile, and balance the C/N ratio.

DO — Deposit humanure into a depression in the top center of the compost pile, not around edges.

DO — Add a mix of organic materials to the humanure compost pile, including food scraps.

DO — Keep the top of the compost pile somewhat flat. This allows the compost to absorb rainwater and makes it easy to cover fresh material added to the pile.

DO — Use a compost thermometer to check for thermophilic activity.

DON'T — Expect thermophilic activity until a sufficient mass has accumulated.

DON'T — Deposit anything smelly into a toilet or onto a compost pile without covering it with a clean cover material.

DON'T — Allow dogs or other animals to disturb your compost pile. If you have problems with animals, install wire mesh or other suitable barriers around your compost, and underneath, if necessary.

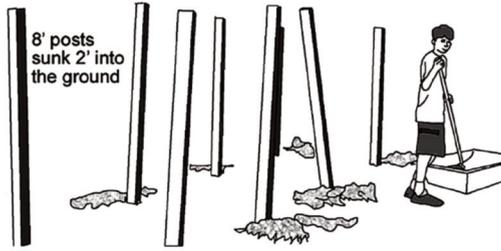
DON'T — Segregate food items from your humanure compost pile. Add all organic materials to the same compost bin.

DON'T — Use the compost before it has fully aged. This means one year after the pile has been constructed, or two years if the humanure originated from a diseased population.

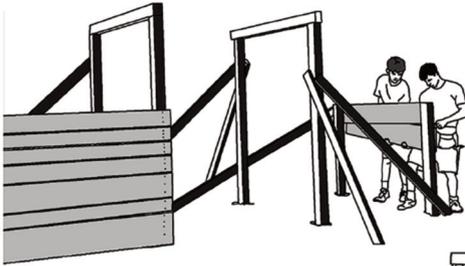
HOW TO CONSTRUCT A

# 3-SECTION COMPOST BIN

1 inch = 2.54 cm

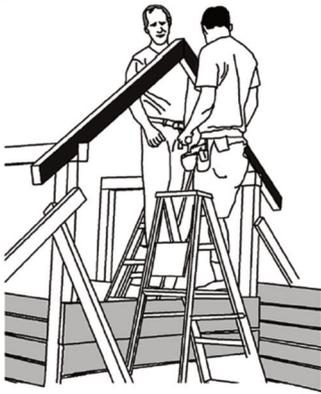


1. Dig eight holes about 24 inches deep and drop in 4x4 posts. Backfill with soil (and concrete mix, if available). Posts are about 5 feet (1.5 meters) apart. Leave the four center posts full length. Cut the four outer posts to a height of about 4 feet (1.2 meters).



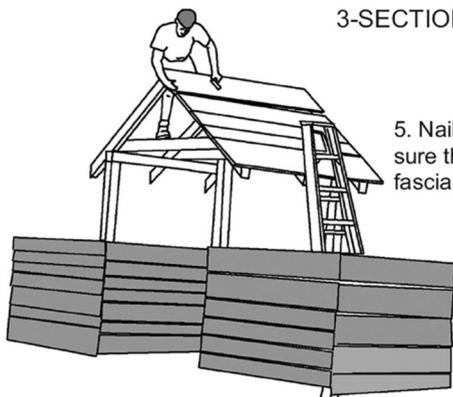
2. Vertically plumb and then brace the posts. Nail a 4-inch by 4-inch (10 cm by 10cm) header across the four high posts.

3. Screw or nail boards to the posts as shown. There is no need to leave a gap between the boards. If you're in a cold climate with frost heave, leave about 2 inches (5 cm) between the bottom board and the ground.



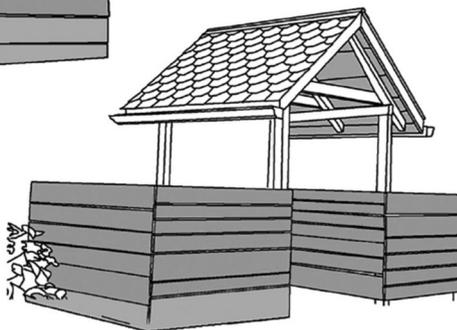
4. Cut the rafters and build a simple gable roof (or a simpler shed roof if you prefer, although the two front or back posts would need to be longer to allow for roof slope). The ground posts should be rot resistant. The sidewalls should not be treated with toxic chemicals. Periodically, the wall boards will need to be replaced. The central roof keeps the cover material dry so it won't freeze in a cold climate. The entire compost bin can be built from recycled lumber, if available.

### 3-SECTION COMPOST BIN (cont.)



5. Nail roof boards to the rafters. Make sure the rafter ends have plumb cuts so a fascia board can be attached.

6. Install fascia boards, then install the finished roofing. Recycled slate is an excellent roofing material.



7. Install the rain spouting. Install a rain barrel. You will have to drain the barrel during freezing weather.

The author's three-chambered compost bin in Pennsylvania, USA, includes a center chamber for storing cover material, usually straw bales. The bin on the right is being added to (the "active" bin), while the bin on the left is beginning to be emptied out. Rainwater is collected off the center bin roof and used to wash toilet receptacles.



ing. If for some reason your compost pile does suddenly fill up and you have nowhere to deposit the compost material, then you will simply have to start a new compost bin. Four wooden pallets on edge, stacked straw bales, or wire fencing will make a quick bin in an emergency.

The system outlined above will not yield any compost for two years (one year to build the first pile and an additional year for it to age). However, after the initial two-year start-up period, an ample amount of compost will be available on an annual basis.

If you're composting humanure from a population with endemic diseases, an additional year-long curing period should be considered. This will require additional compost bins. In that situation, after a bin is filled, it is left to rest for *two* years. This system will create a longer lag time before compost is available for agricultural purposes. If in doubt about the hygienic safety of any compost, either test it for pathogens in a laboratory, or use it agriculturally where it will not come in contact with food crops, and wear gloves when handling it.

Finally, all organic material goes into the same bin! Food scraps, toilet material, animal mortalities, stale beer, the whole works. If you have animals and want to add the animal manures, that's fine; you may just need additional bins because they may fill up faster. Yes, you can compost toilet paper. Yes, you should compost your food scraps and your toilet material in the same bin — it makes better compost!

#### LEACHATE

Compost requires a lot of moisture and prefers to be kept damp. Evaporated moisture is one of the main reasons that compost shrinks so much. Compost piles are not inclined to drain moisture unless subjected to an excessive amount of rain or other influx of liquid. Most rainwater is absorbed by the compost, but in heavy rainfall areas a roof or cover can be placed over the compost pile at appropriate times to prevent leaching. This roof can be as simple as a piece of plastic or a tarp. You can also add more cover material on top of the pile to protect it from heavy rains. The biological sponge acts as a leachate barrier too.

You can also create leachate if you use too much wash water to clean toilet receptacles, because the wash water goes into the pile. If your compost seems too wet, add more drier material into your compost mix when building your pile. And don't use too much wash water. If you're washing a lot of receptacles at once, say a dozen, a gallon of water is enough to provide an initial rinse for all of them. Dump the gallon into the first receptacle, rinse it, dump the same water into the next receptacle, rinse, and repeat. Then dump that water into the compost bin. Use another gallon with a small amount of soap to wash the next dozen or so five-gallon receptacles. Dump that into the compost bin, then use another gallon to give them all a final rinse to get the soap washed out. Dump that into the bin too. Soap won't hurt anything in your compost. You will have used three gallons of water to clean sixty gallons of toilet contents, or a ratio of 1/20. That means you only used a liter (about a quart) per five-gallon receptacle by following this procedure.

If you don't like washing loo receptacles and don't mind spending the money, buy compostable plastic bag liners for your loo. That eliminates much of the wash water. Some people use newspapers to line their loo receptacles. Then, when they empty the containers, the newspaper and the humanure go into the compost pile together.

We had record rainfall the year I wrote this. Sixty inches. Not only did I not have leachate problems, I dumped five gallons at a time of discarded beer from a brewery into my piles, and they loved it. Remember, microbes don't walk, they swim. Keep your piles moist.

#### COMPOST BIN REVIEW

In review, here are the important considerations when making and using compost bins:

- (1) Make sure the bin is above ground, stable, and vermin proof. You may need to line it with wire mesh if you live in a rat-infested area.
- (2) If possible, start the bin on a soil base with a bowl-like depression in the bottom.
- (3) Always start with a "biological sponge" underneath the pile.

(4) Add your fresh material into a depression in the center of the bin. Always put smelly organic material *in* the bin, never *on* the bin. Layering compost like lasagna? Forget it; that's obsolete. Center feeding works much better.

(5) Always cover the contents of the bin. If you see flies or smell odors, you are not covering adequately or properly. Cover it until there is no odor and there are no flies.

(6) Build a layer of cover material around the insides of the bin. This happens naturally when you're feeding new material into the center of the bin.

(7) Once the bin is full, let it sit, undisturbed, for about a year. Keep a layer of cover material on top at all times. You can use the old cover material as your biological sponge in the next bin after you empty out the compost. There is no advantage in trying to rush compost. Immature compost kills plants. It doesn't cost anything to let the compost age and cure. That's how you get the best, most agriculturally useful, most hygienically safe compost.

#### MANAGEMENT IS NECESSARY

The final *necessary* element in a compost toilet system: human management. It's not a "take a dump and let someone else deal with it" situation, like a water toilet. You, or someone, must take responsibility for the compost toilet you're using. Receptacles must be cleaned, emptied, and available for use at all times. Cover material must be supplied, and the compost pile must be managed responsibly. It helps if the manager of the system is also someone who wants and values the compost. Making compost is creating something of value. There's not much point in making it if it's not going to be constructively utilized.

You will often hear that composting is both a science and an art and that's true. The point is to recycle organic material in an odor-free, nuisance-free, environmentally safe and hygienically effective manner. Pay attention to what you're doing, and adjust things over time as needed. A compost toilet system will quickly fail if managed poorly.

## SOME THESIS DATA

Here is some old graduate thesis data worth reviewing. After fourteen years of humanure composting I analyzed my garden soil, my yard soil (for comparison), and my compost, each for fertility and pH, using LaMotte test kits from the local university.<sup>3</sup> I also sent samples of my feces to a local hospital lab to be analyzed for indicator parasitic ova or worms. That was back in 1993.

The humanure compost proved to be adequate in nitrogen (N), rich in phosphorus (P) and potassium (K), and higher than either the garden or the yard soil in these constituents as well as in various beneficial minerals. The pH of the compost was 7.4 (slightly alkaline), but no lime or wood ashes had been added during the composting process. The garden soil was slightly lower in nutrients (N, P, K) than the compost, and the pH was also slightly lower at 7.2. I had added lime and wood ashes to my garden soil over the years, which may explain why it was slightly alkaline. The garden soil, however, was still significantly higher in nutrients and pH than the yard soil (pH of 6.2), which remained generally poor.

My stool sample was free of pathogenic ova or parasites. I used my own stool for analysis purposes because I had been exposed to the compost system and the garden soil longer than anyone else in my family by a number of years. I had freely handled the compost, with bare hands, year after year, with no reservations. I repeated the stool analysis a year later, after fifteen years of exposure, then again eleven years later, after twenty-six years of exposure, again with negative results. Hundreds of people had used my compost toilet over the years, prior to these tests.

These results indicated that humanure compost is a good soil builder, and that no intestinal parasites were transmitted from the compost to the compost handler after twenty-six years of continuous, unrestricted, unprotected use in the United States. Over the entire twenty-six-year period, almost all of the compost my family had produced had been used in our food garden. We raised a lot of food with

that compost, and a crop of lovely and healthy children with that food.

Some may surmise that the ova & parasite lab analyses I had done were pointless. They didn't prove anything because there may not have been any contamination by intestinal parasites in the compost to begin with. If, after twenty-six years and hundreds of users, no such contaminants made their way into the compost, then that's important information. This suggests that the fears of humanure composting are grossly overblown. The point is that my compost has not created any health problems for me or my family; on the contrary, it has provided us with a garden for decades without the need to import outside manures. That very important point is one that fecaphobes should take note of.

### MONITORING COMPOST TEMPERATURE

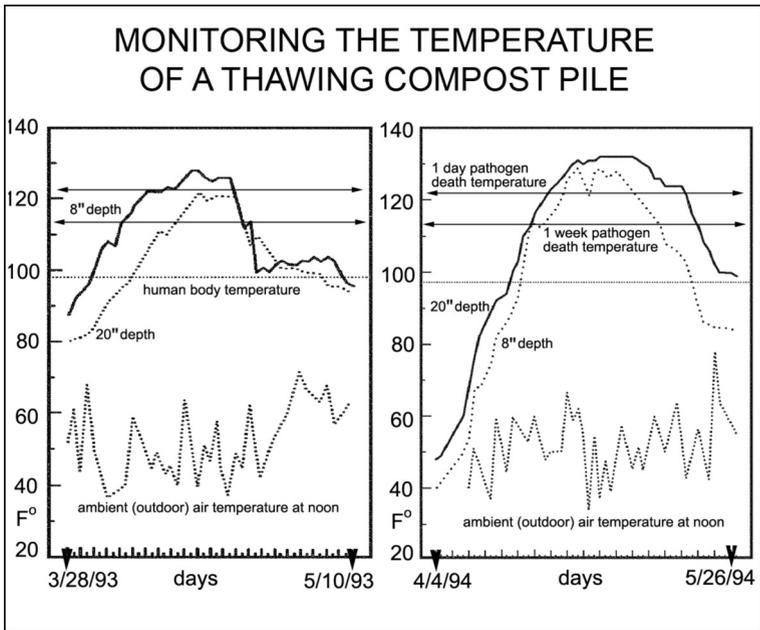
I keep a compost thermometer in my active compost piles at all times. By checking the thermometer, you can tell at a glance how active your compost is. Back in 1993 in grad school, I charted the temperature of my thawing spring compost piles for two years in a row. Over the winter, the compost had frozen solid as a shitcicle, and I wanted to see what was happening after the piles thawed out. The compost consisted primarily of deposits from the compost toilet, which contained hardwood sawdust; humanure including all urine; and toilet paper. Kitchen food scraps were also added to the pile intermittently throughout the winter, and hay was used to cover the toilet deposits. Some weeds and leaves were added, too.

The material was continuously collected from a family of four. Nothing special was done to the pile at any time. No unusual ingredients were added, no compost starters, no water, no animal manures other than human (although a little chicken manure was added to the 1994 pile charted on the right, which may explain the higher compost temperatures). No turning was done whatsoever. The compost piles were situated in a three-sided, open-top wooden bin on bare soil, outdoors. The only imported materials were raw sawdust, a locally abun-

dant resource, and hay from a neighboring farm (less than two bales were used during the entire winter).

Two thermometers were used to monitor the temperature of this compost, one having an eight-inch probe, the other having a twenty-inch probe. The outside of the pile (eight-inch depth) shown on the left graph heated by thermophilic activity before the inside (twenty-inch depth). The outside thawed first, so it became biologically active first. Soon thereafter, the inside thawed and heated. By April 8, the outer part of the pile had reached 122°F (50°C), and the temperature remained at that level or above until April 22 (a two-week period). The inside of the pile reached 122°F on April 16, over a week later than the outside, and remained there or above until April 23. The pile shown in the right graph was above 122°F for twenty-five days.

Since 1993 I have monitored my compost temperatures continuously, year-round. The compost typically reaches 120°F (about 50°C) or above, at a depth of twenty inches, in early spring and stays there all summer and fall. In the winter, the temperature drops, but the compost piles have not frozen since 1997. In fact, the compost thermophiles



seem to be adapting to the cold winters of Pennsylvania and it is not uncommon for my compost to read temperatures over 100°F all winter long, even when the ambient air temperature is in the single digits. I videotaped during one recent winter when the outside air temperature was 4°F (negative 16°C) and the compost pile was 130°F (54°C). The video is on YouTube along with many others. The maximum temperature I have recorded in my household compost is about 156° F (69°C), but more typical temperatures range from 110°F (43°C) to 130°F (54°C). For some reason, the compost seems to stay around 120°F most of the summer months at a depth of twenty inches. I keep the thermometer right in the top center of the pile where new material is added.

According to Dr. T. Gibson, head of the Department of Agricultural Biology at the Edinburgh and East of Scotland College of Agriculture, “All the evidence shows that a few hours at 120° Fahrenheit [49°C] would eliminate [pathogenic microorganisms] completely. There should be a wide margin of safety if that temperature were maintained for 24 hours.”<sup>4</sup>

I wrote the following three paragraphs on February 24, 2005:

“I emptied four humanure compost receptacles this morning before I started writing. The outdoor temperature was 22°F (-6°C). The compost temperature at twenty inches deep was just over 100°F (38°C). I glanced at the clock before I started emptying the compost, then again after I had finished and washed my hands. Exactly fifteen minutes had elapsed. This is a weekly chore and more time consuming in the winter because a gallon jug of water must be carried out with the compost to rinse the containers (the rain barrel at the Humanure Hacienda is drained during the winter months so no water is available there). I have never paid much attention to how time-consuming humanure composting can be, so I was surprised that it only took fifteen minutes to empty four receptacles at a leisurely pace during the worst time of year.

“I shouldn’t be surprised, though, because we’ve developed an efficient system over the years — we use a four-receptacle system because two receptacles are easier to carry than one, and four receptacles will last approximately one week for a family of four, which means only

feeding the compost pile on a weekly basis, usually on Sunday (making compost is more spiritually meaningful to me than going to a church). In the winter, one gallon of water is used for rinsing two compost receptacles. That means four people will need 1/2 gallon of water each per week for toilet use, requiring about four minutes per person per week for feeding the compost pile.

“Granted, there is additional time required to acquire and stockpile cover materials — a job usually done in the summer or fall (we go through about ten bales of straw or hay each year, plus a pick-up truck load of sawdust). A few minutes each week are also needed to refill sawdust containers (a job for the kids). The biggest task is wheelbarrowing the compost to the garden each spring. But then, that’s the whole idea — making compost.”

Now I’m writing the following paragraphs in 2018:

“The kids have grown and moved on. I now only compost for myself and only empty four receptacles once a month. I use five receptacles now. That way, when four are being fed to the compost pile, there is always one in service. The compost pile at my nearby office was 127°F [53°C] a couple nights ago when it was 19°F [-7°C] outside. I attribute the microbial activity to the 15 gallons of room temperature beer I dumped into the pile during a recent week of cold weather (five gallons each night). I get the beer from a local brewery — it’s what drains from the tap as froth or overflow, into a bucket. They were dumping it down a sink drain every night, but now I collect it. It gives me a good excuse to go in and have a beer, and my compost loves it.

“My house compost pile was only 60°F [16°C] today. I have not fed it in over a month (I was in Europe). The weather has been frigid. Today I emptied six toilet receptacles into the pile, a bucket of beer, and a dead possum. I’m sure the temperature will rise quickly [it rose to 126°F (52°C)]. Compost likes to be fed. If you don’t feed it, the temperature will drop. If you feed it, the temperature will rise again.

“My pile has not frozen in twenty-one years and I don’t expect it to freeze again. The cover material surrounding the pile is helpful because it helps insulate the compost during cold weather, and it helps

with oxygen infiltration. Also, my compost bacteria have reproduced so many generations in nearly forty years that I wouldn't be surprised if they've become naturally selected for the local climate. They, like me, live here now. It's their home too. Plus, adding liquids to the piles in the winter helps a lot to keep the temperatures up. Climate change may be having an effect too. We've had some weird warm weather during the winter months over the past decade, plus a fair share of nasty cold weather and blizzards.

“I used to call my compost pile Gomer (Gomer the pile), but nobody knows what that means anymore. Even bad humor eventually expires.”

### COMPOST HAPPENS

Fears of compost exist perhaps because much of the information in print concerning the recycling of humanure is confusing, erroneous, or incomplete. For example, when researching the literature during the preparation of an earlier edition of this book, I found it surprising that almost no mention is ever made of the composting of humanure as a viable alternative to other forms of on-site sanitation. When “bucket” systems are mentioned, they are universally decried as being the least desirable sanitation alternative.

For example, in *A Guide to the Development of On-Site Sanitation* by Franceys et al., published by the World Health Organization in 1992, “bucket latrines” are described as “malodorous, creating a fly nuisance, a danger to the health of those who collect or use the night soil, and the collection is environmentally and physically undesirable.” This sentiment is echoed in Rybczynski's (et al.) World Bank funded work *Appropriate Technology for Water Supply and Sanitation*, where it is stated that “the limitations of the bucket latrine include the frequent collection visits required to empty the small container of [humanure], as well as the difficulty of restricting the passage of flies and odors from the bucket.”

I've personally used a compost toilet for forty years, and it has

never caused odor problems, fly problems, health problems, or environmental problems, even when a bucket was used as a receptacle. Quite the contrary, it has actually enhanced my health, the health of my family, and the health of my environment by producing healthy, organic food in my garden, and by keeping “human waste” out of the water table. Nevertheless, Franceys et al. go on to say that “[humanure] collection should never be considered as an option for sanitation improvement programs, and all existing bucket latrines should be replaced as soon as possible.” Now you see why I say never use the term “bucket’ in association with a compost toilet. A compost toilet is not a bucket latrine.

Obviously Franceys was referring to the practice of collecting humanure in buckets without a cover material and without any intention of making compost. Such buckets of feces and urine were presumably dumped raw into the environment. Naturally, such a practice should be strongly discouraged, if not outlawed.

However, rather than forcing people who use such crude waste disposal methods to switch to other prohibitively costly waste disposal systems, perhaps it would be better to educate those people about recycling, the human nutrient cycle, and about composting. It would be more constructive to help them acquire adequate and appropriate cover materials for their toilets, assist them in constructing compost bins, and thereby eliminate waste, pollution, odor, flies, and health hazards altogether. I find it inconceivable that intelligent, educated scientists who observe bucket latrines and the odors and flies associated with them do not see that the simple addition of a clean, organic cover material to the system would solve these problems and would balance the nitrogen of the humanure with carbon, thereby allowing composting to happen.

Franceys et al. state, however, in their book that “apart from storage in double pit latrines, the most appropriate treatment for on-site sanitation is composting.” I would agree that composting, when done properly, is the most appropriate method of on-site sanitation available to humans. I would not agree that double pit storage is more appropri-

ate than composting unless it could be proven that human pathogens could be adequately destroyed using such a double pit system, and that such a system would be comfortable and convenient, would produce no unpleasant odor, and would not require the segregation of urine from feces. According to Rybczynski et al., the double pit latrine shows a reduction of *Ascaris ova* of 85 percent after two months, a statistic that does not impress me. When my compost is finished, I don't want any pathogen threat lurking in the compost that's in my bare hands.

Ironically, the work of Franceys et al. further illustrates a “decision tree for selection of sanitation” that indicates the use of a “compost latrine” as being one of the least desirable sanitation methods, and one that can only be used if the user is willing to collect urine separately. Unfortunately, contemporary professional literature is rife with this sort of inconsistent, incomplete, and incorrect information that would surely lead a reader to believe that composting humanure just isn't worth the trouble.

On the other hand, Hugh Flatt, who, I would guess, was a practitioner and not a scientist, in *Practical Self-Sufficiency* tells of a compost toilet system he had used for decades. He lived on a farm for more than thirty years that made use of “sawdust toilets.” The lavatories serviced a number of visitors during the year and often two families in the farmhouse, but they used no chemicals. They used sawdust, added after each use of the toilet, which Mr. Flatt described as “absorbent and sweet-smelling.” The toilet was emptied on a compost pile. The compost heap was located on a soil base with a floor of “cut weeds, grass, or straw.” The deposits were covered each time they were added to the heap, and kitchen refuse was added to the pile (as was straw). The result was “a fresh-smelling, friable, biologically active compost ready to be spread on the garden.”<sup>5</sup>

In 2018 toilet material collected in receptacles for processing was being termed “container-based sanitation” by sanitation professionals to distinguish from bucket latrines. Compost toilets are “compost-based sanitation” because the emphasis is on the composting rather than on the container.

Those who use composting for sanitation might view the comments of some “experts” with annoyance. For example, someone posted a query on a compost toilet forum wondering if anyone had any scientific criticism about humanure composting. An “expert” replied that he was about to publish a new book on “composting toilets,” and he offered the following excerpt:

*Warning: If you don't have a consistent track record of maintaining high temperatures in quick compost piles, I'd counsel against using this system. Even among gardeners, only a small minority assemble compost piles which consistently attain the necessary high temperatures. . . .Health issues I'd be concerned about are 1) bugs and small critters fleeing the high-temperature areas of the pile and carrying a coat of pathogen laden feces out of the pile with them; 2) large critters (dogs, raccoons, rats. . . .) raiding the pile for food and tracking raw waste away; and 3) the inevitable direct exposure from carrying, emptying, and washing buckets.*

*Some clever and open-minded folk have hit on the inspiration of composting feces . . . by adding them to their compost piles! What a revolutionary concept! . . . Sound too good to be true? Well, in theory it is true, though in practice I believe that few folks would pass all the little hurdles along the way to realizing these benefits. Not because any part of it is so difficult, just that, well, if you never ate sugar and brushed and flossed after every meal, you won't get cavities either.<sup>6</sup>*

He's right about the cavities, but not about the rest. The comments are lacking in scientific merit and expose someone who has no experience about the subject on which he is commenting. It is disheartening, but not surprising, that such opinions would actually be published. The writer hits on knee-jerk fears of fecaphobes. His comment on bugs and critters fleeing the compost pile coated with pathogen-laden feces is a perfect example. Perhaps someone should inform this person that fecal material is a natural product of the human body, and that if it is laden with pathogens, that person needs help.

When one lives with a composting system for an extended period, one understands that fecal material is readily compostable, comes from one's body, exists inside oneself at all times, and is teeming with *beneficial* microorganisms. With such an understanding, it would be hard to be fearful of one's own humanure, and impossible to see it as a substance brimming with disease organisms, unless, of course, one is brimming with disease.

The writer hits on another irrational fear — large animals, including rats, invading a compost pile and spreading disease. Compost bins can be easily built to be animal-proof. If small animals such as rats are a problem, the compost bin can be lined with chicken wire on all sides and underneath. The compost bins should have side walls such as pallets, blocks, straw bales, wood boards, or similar barriers to keep out larger animals. A simple piece of wire fencing cut to fit the exposed top of an active compost pile will keep animals from digging into it, while still allowing rain water to keep the pile moist. With adequate cover material on the pile, there will be no flies. It's pretty simple.

The writer warns that most gardeners do not have hot compost. Most gardeners also leave critical ingredients out of their compost, thanks to the fear-mongering of the ill-informed. Those ingredients are humanure and urine, which are quite likely to make one's compost heat up.

As we have seen, it's not only the temperature of the compost that destroys pathogens, it's also retention time. Compost that includes toilet material requires approximately a year's undisturbed retention time (give or take) after the pile is built. When a thermophilic phase is added to this process, I would challenge anyone to come up with a more effective, earth-friendly, simpler, low-cost system for pathogen elimination, assuming pathogens are there in the first place.

Finally, the writer warns of "the inevitable direct exposure from carrying, emptying, and washing buckets." Wiping one's butt after defecating requires more "direct exposure" than emptying compost, but I would not discourage people from doing it. It is quite simple to wash one's hands after defecating and after taking care of the compost.

Other experts have thrown in their two cents worth on composting humanure. A book on dry toilets mentions the compost toilet system.<sup>7</sup> Although the comments are not at all cynical and are meant to be informative, a bit of misinformation manages to come through. For example, one suggestion is to use “rubber gloves and perhaps a transparent face mask so you do not get anything splashed on you” when emptying a compost receptacle onto a compost pile. Yes, that advice should be followed when making compost using toilet material collected from a population with known health problems, such as areas endemic with intestinal parasites. But you? How is it that what has just emerged from your own body can be considered so utterly toxic? Can one not empty a container into a compost pile without splashing the contents all over one’s face? More exaggeration and misinformation existed in the book regarding temperature levels and compost bin techniques. One warning to “bury finished compost in a shallow hole or trench around the roots of non-edible plants,” might apply to dry-toilet septage but not to compost. The authors recommended that humanure compost be composted again in a non-humanure compost pile, or microwaved for pasteurization, both ridiculous suggestions.

The act of composting humanure is so radical and revolutionary that people who have spent their lives trying to dispose of the substance can’t quite come to grips with the idea that it can be recycled. Ironically, a simple compost toilet used by a physician and his family is featured and illustrated in the above book (and in my *Compost Toilet Handbook*). The physician states, “There is no offensive odor. We’ve never had a complaint from the neighbors.” Their compost toilet system is also illustrated and posted on the internet, where a brief description sums it up: “This simple compost toilet system is inexpensive both in construction and to operate and, when properly maintained, aesthetic and hygienic. It is a perfect complement to organic gardening. In many ways, it out-performs complicated systems costing hundreds of times as much.” Often, knowledge derived from real-life experience can be diametrically opposed to the speculations of “experts.”

What about “health agents”? Health authorities can be misled by

misinformation, such as that stated in the preceding accounts. Health authorities, according to my experience, generally know very little, if anything, about composting. The health authorities who have contacted me are very interested in getting more information and seem very open to the idea of a natural, low-cost, effective, humanure recycling system. They know that human sewage is a dangerous pollutant and a serious environmental problem, and they seem to be surprised and impressed to find that such sewage can be avoided altogether. Most intelligent people are willing and able to expand their awareness and change their attitudes based on new information. Therefore, if you are using a compost toilet and are having a problem with any authority, I will donate, free of charge, a copy of *The Humanure Handbook*, fourth edition, to any permitting agent or health authority, no questions asked, upon anyone's request — just send a name and address to the publisher at the front of this book (foreigners will get download links).

Well-informed health professionals and environmental authorities are aware that “human waste” presents an environmental dilemma that is not going away. The problem, on the contrary, is getting worse. Too much water is being polluted by sewage and septic discharges, and there must be a constructive alternative. When health authorities learn about composting, they realize there may very likely be no better solution to the human waste problem. Perhaps this is why I received a letter from the US Department of Health and Human Services praising an earlier edition of this book and wanting to know more about humanure composting. The US Environmental Protection Agency wrote to me to commend this book and order several cases. The Pennsylvania Department of Environmental Protection nominated the book for an environmental award and the US Composting Council presented the author with a national award for grassroots education. Fecaphobes may think composting humanure is dangerous and disgusting. I will patiently wait until they come up with a better solution to the problem of “human waste,” but I won't hold my breath waiting.

## LEGALITIES

Composting humanure can't be legal, can it? Well, yes actually, it probably is, depending on your situation, and here's why. Waste disposal is regulated, and it should be. Waste disposal is potentially very dangerous to the environment. Sewage disposal and recycling are also regulated, and they should be, too. Sewage, as we already know, includes a host of hazardous substances deposited into a waterborne waste stream. The process of composting humanure is neither disposal of waste, nor production of sewage — it is the recycling of organic material. It's *composting*. Both backyard composting and farm composting are generally exempt from regulations unless the compost is being sold or removed from the property on which it is made, or the compost operation is large. The National Sanitation Foundation has nothing to do with composting. Composting is not a wastewater treatment system and is not subject to the regulations that govern such systems.

To quote one source, “The US Department of Environmental Protection (DEP) has established detailed regulations for the production and use of compost created from [organic material]. These regulations exclude compost obtained from backyard composting and normal farming operations. Compost from these activities is exempt from regulation only if it is used on the property where it was composted, as part of the farming operation. Any compost which is sold must meet the requirements of the regulations.”<sup>8</sup>

Dry toilets that dehydrate and degrade the organic material inside them, producing septage, are regulated in many states. A compost toilet does not degrade organic material; it simply collects it. If the composting occurs on private property and the compost is not being sold, it is most likely not regulated. If someone tells you that it is illegal to compost humanure on your property, ask them to produce the statute or regulation so you can see for yourself. It probably doesn't exist.

At one point in time I was engaged as a plaintiff in a group lawsuit against the local municipality. The borough had issued a building permit to a polluting industry in violation of the zoning ordinances. Our

## FREQUENTLY ASKED QUESTIONS ABOUT COMPOST TOILETS

- **Should a compost toilet be inside or outside?** Inside. It is much more comfortable during cold and wet weather. The contents of an outside toilet will freeze in the winter and will be very difficult to empty into the compost bin. Keep a clean layer of sawdust over the toilet contents at all times and you won't have any odor inside.
- **Can the compost toilet receptacle be left for long periods without emptying?** The toilet receptacle can sit for months without emptying. Just keep a clean layer of sawdust or other cover material over the contents.
- **Will the toilet material compost inside the toilet receptacle?** No. It will *not* start to compost in the toilet receptacle. It won't start composting until you put it in your compost pile.
- **How full should the compost toilet receptacle be before it's emptied?** You know it's time to empty the toilet when you have to stand up to take a shit.
- **Why doesn't the toilet smell bad?** The adequate amount of the correct cover material will allow for an odor-free system. Therefore, a humanure toilet can be used almost anywhere, such as in an office or bedroom. If you don't cover the toilet contents, it will stink like hell.
- **Will my outdoor compost bin smell bad and cause complaints?** Absolutely. If you don't keep a layer of cover material on the active compost bin it will stink like hell and your neighbors will have you tared and feathered, and they should. If you detect odor emanating from your pile, add cover material until it stops.
- **Why won't the compost pile leach pollutants?** Start your pile on a concave surface with a biological sponge underneath it to prevent leachate during the early stages of the compost pile. A hot compost pile craves moisture — liquids don't leach from it, unless it's a monsoon.
- **Should a compost pile be separated from the earth by a waterproof barrier to prevent leaching?** No. The earth/compost interface is important. However, in some cases when compost is made on an impermeable barrier under wet conditions, any leachate should be collected in a receptacle filled with cover material, then added back to the compost pile.
- **What sort of seal should I use around the toilet seat lid?** You don't need a seal around the toilet seat lid. The "seal" is created by the organic material that covers the humanure.
- **Can I use wood chips in my compost? What else?** Don't use wood chips or wood shavings. Chips are bad; shavings will compost, but they take a long time and don't make good compost. They're lousy in a toilet because it takes a lot of them to mask odor and then they throw the carbon/nitrogen ratio off balance and your compost won't heat up. Use a finer material in your toilet. Use hay, straw, weeds, leaves, and grass clippings on your pile. Not wood chips.
- **When I empty the contents of several toilet receptacles at once, should I cover each one separately with a bulk cover material so as to trap air in the compost pile?** No. Air is already trapped in the sawdust. When emptying several toilet receptacles at once, just empty them into a depression in the top, center of the pile, *then* cover. One mistake people make is thinking they need to create a layered pile for aeration purposes. In fact, if you layer too much cover material into the pile, it may become too dry and not heat up at all. Although there needs to be oxygen in the pile, there also needs to be a lot of moisture.
- **What about winter composting? Can I add to a snow-covered compost pile?** You can deposit compost materials on top of the snow. The main problem in the winter is the cover material freezing. So you need to cover your leaves, sawdust, hay, or whatever you use so they don't freeze. You can throw a tarp over an outdoor pile of sawdust, then cover that with a thick layer of straw, for example. Or you can bring sawdust indoors in a wheelie bin (plastic garbage can) during the winter, too. That works pretty well.
- **Can I just throw my organic material on top of the pile?** No! Put organic material INTO a compost pile, never ONTO a compost pile. The *only* exception is the cover material. Part the cover material, create a depression in the top center of the compost, then add your fresh material there. Rake the existing compost back over it and then cover with the cover material.
- **Does a compost bin need to have an open side? Shouldn't a bin be enclosed in an urban situation?** You don't need an open side. Someone wrote from Manhattan who had installed humanure toilets in a communal home, and he made a four-sided bin (one side removable) with a heavy screen top to keep out anything that might want to try to get in (like rats, skunks, snakes, or politicians). That seemed like a good idea for a city situation (a screen bottom may be necessary, too). Wrap your bins in chicken wire if animals are a problem.
- **Where do you keep your sawdust? I can't seem to decide where to store it.** I have lots of outdoor space, so I have a dump truck bring me a load of sawdust every few years and dump it

## FREQUENTLY ASKED QUESTIONS ABOUT COMPOST TOILETS

out by my compost bins. If I didn't have that option, I might try using peat moss, which is handily packaged and could be kept indoors, or store sawdust indoors in feed sacks or wheelie bins, or use a three-chambered compost bin and put the sawdust in the center.

• **How do I know the edges of the compost pile will get hot enough to kill all pathogens?** You will never be absolutely certain that every tiny bit of your compost has been subjected to certain temperatures, no matter what you do. If in doubt, let it age for an additional year, have it tested at a lab, or use the compost on nonfood crops.

• **Can I build my compost bin under my house and defecate directly into it?** Yes, but I have never tried this and can't personally vouch for it. You may have odor issues.

• **What about meat and dairy products in compost?** They'll compost. Dig them into the top center of the pile, and keep it all covered with a clean, organic material.

• **What about building codes, septic permits, and other government regulations?** Some composters are inclined to believe that government bureaucrats are against compost toilets.

This is more paranoia than truth. Alternative solutions are becoming more attractive as the sewage issue continues to get worse. Government agencies are looking for alternative solutions that work, and they are willing to try new things. Their concerns are legitimate, and change comes slowly in government. If you work cooperatively with your local authority, you may both be satisfied in the end.

• **What about flies and rats in the compost?** Flies won't be a problem if the compost is adequately covered. If you have rats, you may have to envelop your compost bin in wire mesh if you can't get rid of them. The solution for rats in Haiti was cats.

• **Can I use softwood sawdust in my compost?** Yes. Make sure it's not from "pressure treated" lumber. The sawdust can be moist but shouldn't be wet. If using cedar, redwood, or other rot-resistant sawdust, make sure it is well rotted (aged) outdoors first.

• **What about using railroad ties to make compost bins?** The creosote is not good for your compost, so railroad ties are not recommended.

• **What about using dog doo in compost?** Doggy doo will compost, as will cat litter. You can also compost entire dead dogs and cats. If this makes you uncomfortable, use a separate bin for doggy doo and cat litter.

• **What about coffee filters and barbecue ashes?** Throw coffee filters in your compost. Grounds, too, and even old coffee. Tea bags, too. Barbecue ashes? Maybe throw them in your flower beds along with any wood ashes.

• **If I don't want to start using humanure in my compost now, could I do it on short notice in the event of a municipal emergency?** In the event of a serious municipal emergency, yes, you could immediately begin composting humanure, as long as you had a source of clean cover material (sawdust, leaves, etc.) and a compost bin. Compost piles work much better when you feed them manure and urine and other nitrogen sources such as grass clippings and greenery. You may find that humanure and urine greatly improve your compost.

• **What is the hottest temperature you have recorded in your compost? Can it get too hot?** About 150F (65C). Yes, it can get too hot. A cooler pile over a longer period is ideal.

It's more likely your compost won't get hot enough. This is often due either to a dry pile (make sure you collect and compost all urine), the use of wood chips or shavings (do not use wood *chips* or *shavings* — use sawdust), or the excessive use of layered cover material (you do not have to layer cover material into the pile — keep the cover material on top and around the edges; enough will infiltrate the pile without you're having to layer it.

• **Can you compost humanure with a large family? Would it be too labor intensive?** For a family of six to ten, depending on body weight, a five-gallon toilet receptacle would fill daily.

A bigger concern would be the supply of organic cover material, which would amount to about five gallons of volume daily also. You would need several compost bins and a place to put them.

• **What about composting on a flood plain? Would a pit latrine work better?** Don't compost on a flood plain. Don't use a pit latrine. Pit latrines are illegal because they cause pollution.

• **What are some other compost bin designs?** One design consists of two concentric wire bins with leaves stuffed in between and the humanure going into the center. Another is a bin composed entirely of straw or hay bales. Another design consists of simple wooden pallets arranged on their sides and tied or screwed together to form compost bins.

• **Do you recommend using chlorine bleach as a disinfectant?** No. It's an environmental contaminant. Try hydrogen peroxide, or just use soap and water.

lawsuit was on the front page of the county paper repeatedly and things got ugly. Some of the plaintiffs even received death threats. An ignorant neighbor anonymously reported to the Department of Environmental Protection that I was disposing of toxic waste on my property. The DEP sent a plain-clothes investigator in an unmarked car to check it out. He did the investigation without my knowledge, then walked into my office with the anonymous report in his hand. After he explained himself, he said that he found no evidence of any toxic waste and that he would file the complaint as being without merit.

A couple of years later, I arranged a meeting with the Pennsylvania DEP in the capital city of Harrisburg. I did a PowerPoint presentation for them about humanure composting and explained that I wanted a permit to collect and compost humanure from larger populations such as music venues, environmental centers, and so on. I wanted both the experience and the data. Also, I own many acres of unreclaimed strip-mined land, and the compost could be put to good use there for reclamation if I composted it on my own property. The DEP was very understanding and supportive. They emailed me the permit application a few days later. It was about 100 pages long and would take me a month to process, a period that was not available to me at that time. An environmental engineer offered to process the application for me, for \$35,000. The project ground to a halt.

Then I received a phone call one evening from Patricia Arquette, a Hollywood actress, asking me if I would go to Haiti and teach them how to set up compost toilets for the people now living in tent cities after the earthquake, which I did. That was 2010. Since then, with the help of Patricia's group, GiveLove.org, and in particular Alisa Keesey, the program director, and Samuel Souza, the compost instructor, I have been able to gather data on larger scale composting without having to deal with US regulations at all.

When I attended the US Composting Council conference in Austin, Texas, a few years ago, as I waited in the auditorium for the keynote speaker, I struck up a conversation with the lady sitting next to me. She was a health department authority in a state I don't remem-

ber; Missouri, I think. I told her I was involved with humanure. “I’ve heard of that,” she said. Oh yeah, how? “We got a complaint that someone was composting humanure in their backyard in the city. We went to investigate, and the homeowners admitted that they were in fact composting humanure. They said they would stop. So, we left.”

I looked her straight in the eye and asked, “Is what they were doing illegal?” She looked me straight in the eye and said, “No.” Apparently the homeowners thought it was illegal, but no one told them otherwise. People in the US make the assumption that you can’t compost whatever you want on your own property, but you can, as long as you are not creating a nuisance or giving anybody something legitimate to complain about, such as odors, rats, or liquid leaching out your pile onto someone’s property, all of which are easily avoided.

Another example was a man who contacted me in the past year about his compost toilet in a trailer court. The property had prohibitions against “composting and waterless toilets.” They informed him that, in their opinion, “your sewage is being discharged by means of a bucket directly onto the surface of the ground.” Here were four problems the man had against him: the stigma and reputation of the “bucket toilet,” the health authority’s total lack of knowledge about composting, being on property he didn’t own, and an inability to communicate correctly about his compost toilet system. For example, he failed to describe his toilet as a compost toilet, and he mistakenly referred to the compost toilet receptacles as “buckets,” invoking the bucket toilet curse. His solution was to move his trailer elsewhere.

In Maine, it is apparently illegal to put food scraps down a toilet chute in a commercial dry toilet, even though the food scraps and toilet materials go to the same place in the degradation chamber. Such a regulation makes no sense whatsoever. In Massachusetts, finished compost from dry toilets must be buried under six inches of soil, or hauled away and disposed of by a septage hauler. This is because most dry toilets do not make compost, a topic we have already discussed.

If you’re concerned about your local laws, get online or go to the library and see what you can find about regulations concerning com-

post. Or inquire at your county seat or state agency as statutes, ordinances and regulations vary from locality to locality. If you don't want to dispose of humanure but want to compost it instead, you may have to stand up for your rights.

A reader called from a small state in New England to tell me his story. The man had a compost toilet in his house, but the local municipal authorities decided he could only use an "approved" waterless toilet, meaning, in this case, an incinerating toilet. The man did not want an incinerating toilet because the compost toilet was working well, and he liked making and using the compost. So, he complained to the authorities, attended township meetings and put up a fuss. To no avail. After months of "fighting city hall," he gave up and bought a very expensive and "approved" incinerating toilet. When it was delivered to his house, he had the delivery people set it in a storage room — and that's where it remained, still in the packing box, never opened. The man continued to use his compost toilet for years after that. The authorities knew that he had bought the "approved" toilet, and thereafter left him alone. He never did use it, but the authorities didn't care. He bought the damn thing and had it in his house, and that's what they wanted. The locals obviously weren't related to Albert Einstein.

Another interesting story comes from a fellow in Tennessee. It seems that he bought a house that had a rather crude sewage system — the toilet flushed directly into a creek behind the house. The fellow was smart enough to know that was not good, so he installed a compost toilet. However, an unfriendly neighbor assumed he was still using the direct waste dump system, and the neighbor reported him to the authorities. But let him tell it in his own words:

*Our primitive outhouse employs a rotating 5-gallon receptacle sawdust shitter that sits inside a "throne." Our system is simple & based largely on your book. We transport the poop to a compost pile where we mix the mess with straw & other organic materials. The resident in our cabin before we bought the farm used a flush toilet that sent all sewage directly to a creekbed. An uninformed neighbor complained to the state, assum-*

*ing that we used the same system. The state people have visited us several times. We were forced to file a \$100 application for a septic system, but the experts agree that our hilly, rocky house site is not suitable for a traditional septic system even if we wanted one. They were concerned about our grey water as well as our composting outhouse. My rudimentary understanding of the law is that the state approves several alternative systems that are very complicated and at least as expensive as a traditional septic. The simple humanure toilet is not included & the state does not seem to want any civilian to actually transport his own shit from the elimination site to a different decomposition site. The bureaucrats tentatively approved an experimental system where our sewage could feed a person-made aquatic wetlands type thingie & they agreed to help us design & implement that system. Currently, we cannot afford to do that on our own & continue to use our humanure latrine. The officials seem to want to leave us alone as long as our neighbors don't complain anymore. So, that's a summary of our situation here in Tennessee. I've read most of the state laws on the topic; like most legal texts, they are virtually unreadable. As far as I can tell, our system is not explicitly banned but it is not included in the list of "approved" alternative systems that run the gamut from high-tech, low volume, factory-produced composting gizmos to the old-fashioned pit latrine. For a while now, I've wanted to write an article on our experience and your book. Unfortunately, grad school in English has seriously slowed down my freelance writing.*

In Pennsylvania the state legislature has enacted legislation “encouraging the development of resources recovery as a means of managing solid waste, conserving resources, and supplying energy.” Under such legislation the term “disposal” is defined as “the incineration, dumping, spilling, leaking, or placing of solid waste into or on the land or water in a manner that the solid waste or a constituent of the solid waste enters the environment, is emitted into the air or is discharged to the waters of the Commonwealth.”<sup>9</sup> Further legislation has been enacted in Pennsylvania stating that “waste reduction and recycling are

preferable to the processing or disposal of municipal waste,” and further stating “pollution is the contamination of any air, water, land or other natural resources of this Commonwealth that will create or is likely to create a public nuisance or to render the air, water, land, or other natural resources harmful, detrimental, or injurious to public health, safety, or welfare. . .”<sup>10</sup> In view of the fact that the composting of humanure involves recovering a resource, requires no disposal of waste, and creates no obvious environmental pollution, it is unlikely that someone who conscientiously engages in such an activity would be unduly bothered by anyone. Don’t be surprised if most people find such an activity commendable, because, in fact, it is.

If there aren’t any regulations concerning backyard composting in your area, then be sure that when you’re making your compost, you’re doing a good job of it. It’s not hard to do it right. The most likely problem you could have is an odor problem, and that would simply be due to not keeping your deposits adequately covered with clean “biofilter” material. If you keep it covered, it does not give off offensive odors. It’s that simple. Shit stinks so people will be naturally compelled to cover it with something. That makes sense when you think that thermophilic bacteria are already in the feces waiting for the manure to be piled into a compost bin, so they can get to work. Sometimes the simple ways of nature are truly profound.

What about flies — could they create a public nuisance or health hazard? I have never had problems with flies on my compost. Of course, a clean cover material is always kept over the compost pile.

Concerning flies, F. H. King, who traveled through China, Korea and Japan in the early 1900s when organic material, especially humanure, was the only source of soil fertilizer, stated, “One fact which we do not fully understand is that, wherever we went, house flies were very few. We never spent a summer with so little annoyance from them as this one in China, Korea and Japan. If the scrupulous husbanding of [organic] refuse so universally practiced in these countries reduces the fly nuisance and this menace to health to the extent which our experience suggests, here is one great gain.” He added, “We have adverted to

the very small number of flies observed anywhere in the course of our travel, but its significance we did not realize until near the end of our stay. Indeed, for some reason, flies were more in evidence during the first two days on the steamship out from Yokohama on our return trip to America, than at any time before on our journey.”<sup>11</sup>

If an entire country the size of the United States, but with twice the population at that time, could recycle its organic refuse without the benefit of electricity or automobiles and not have a fly problem, surely we in the United States can recycle a greater portion of our own organic material with similar success today.

### POTTY TRAINING 101

Americans suffer from arrested development when it comes to human excretions. What we put *into* our bodies is celebrated as an art and a science. Ironically, what comes *out* is ignored and avoided. We are held captive to a nineteenth century attitude that our excretions are waste materials choking with disease organisms. Our collective mentality regarding excrement is juvenile at best. We can't talk about it without snickering like thirteen-year-olds, even on radio and TV.

People who are trying to advance the science and especially the practical applications of humanure recycling face pushback from regulatory personnel in the US and in most water toilet cultures. Yet we in the developed world are the ones who have the education and the wherewithal to be *able* to conduct research and development about humanure composting systems.

Composting not only has a positive impact on the Earth's ecosystems but is proven to be sustainable. When Western culture is only a distant and fading memory in the collective mind of humanity thousands (hundreds?) of years from now, the humans who will have learned how to survive on this planet in the long term will be those who have learned how to live in harmony with it. That will require much more than intelligence or technology — it will require a sensitive understanding of our place in the web of life. Perhaps what is required

is a sense of humility, and a renewed respect for that which is simple.

True advancement requires the balanced development of humanity's intellect with physical and spiritual development. We must link what we know intellectually with the physical effects of our behavior, and with the understanding of ourselves as small, interdependent, interrelated life forms relative to a greater sphere of existence.

Perhaps we're really advancing ourselves when we can function healthfully, peacefully, and sustainably without squandering resources and without creating pollution. That's not a matter of mastering technology; it's a matter of mastering oneself, a much more difficult undertaking, but certainly a worthy goal.

